

**CLAIMS:**

1. An apparatus for producing a patterned material comprising:
  - 5 an external land die for extruding a material;
  - a patterned roller in close proximity to said external land die.
- 10 2. An apparatus as in claim 1 wherein said patterned roller is mounted on the gimbals.
- 15 3. An apparatus as in claim 2 wherein said patterned roller is constrained to allow rotation on two axes with respect to said external land die.
4. An apparatus as in claim 1 wherein said patterned roller is mounted for rotation.
5. An apparatus as in claim 1 wherein a distance between said external land die and said patterned roller is adjustable.
- 20 6. An apparatus as in claim 1 wherein said patterned roller is heated.
7. An apparatus as in claim 1 wherein said external land die comprises:
  - 25 a first external land surface; and
  - a second external land surface.
- 30 8. An apparatus as in claim 7 wherein said first external land surface and said second external land surface form a trapezoid with respect to a surface of said patterned roller.
9. An apparatus as in claim 7 wherein:

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said first external land surface creates a diverging region with respect to a direction of rotation of said patterned roller; and

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said second external land surface creates a converging region with respect to said direction of rotation of said patterned roller.

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10. An apparatus as in claim 9 wherein a first hydrodynamic pressure created in said diverging region is less than a second hydrodynamic pressure created in said converging region.

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11. An apparatus as in claim 10 wherein said second hydrodynamic pressure is in excess of  $1.01 \times 10^6$  Pa to compress entrapped air in said material.

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12. An apparatus as in claim 9 wherein the rate of pressure change in the converging region is at least  $1.5 \times 10^7$  Pa/s.

13. An apparatus as in claim 7 wherein:  
a first heater heats said first external land surface; and  
a second heater heats said second external land surface.

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14. An apparatus as in claim 13 wherein said first heater operates at a different temperature than said second heater.

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15. An apparatus as in claim 1 comprising:  
a first end seal at a first end of said external land die;  
a second end seal at a second end of said external land die;  
and  
wherein said first end seal and said second end seal prevent said material from leaking past said first and second end of said external land die.

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16. An apparatus as in claim 1 wherein said patterned roller is vented.

17. An apparatus as in claim 1 wherein said extruded material is molten.

5 18. An apparatus as in claim 1 wherein said material is comprised of at least two separate materials for coextruding at least two separate layers.

10 19. An apparatus as in claim 1 wherein said material is a polymer.

20. An apparatus as in claim 1 wherein said material is a low curtain strength material.

15 21. An apparatus for producing a patterned material comprising:

an external land die for extruding a material;  
a patterned roller in close proximity to said external land die;

20 wherein said patterned roller is mounted on gimbals;  
wherein said patterned roller is mounted for rotation; and  
wherein a distance between said external land die and said patterned roller is adjustable.

25 22. An apparatus as in claim 21 wherein said patterned roller is heated.

23. An apparatus as in claim 21 wherein said external land die comprises:

30 a first external land surface; and  
a second external land surface.

24. An apparatus as in claim 23 wherein said first external land surface and said second external land surface form a trapezoid with respect to a surface of said patterned roller.

5 25. An apparatus as in claim 23 wherein:  
said first external land surface creates a diverging region with respect to a direction of rotation of said patterned roller; and  
said second external land surface creates a converging region with respect to said direction of rotation of said patterned roller.

10 26. An apparatus as in claim 25 wherein a first hydrodynamic pressure created in said diverging region is less than a second hydrodynamic pressure created in said converging region.

15 27. An apparatus as in claim 26 wherein said second hydrodynamic pressure is in excess of  $1.01 \times 10^6$  Pa to compress entrapped air in said material.

20 28. An apparatus as in claim 23 wherein:  
a first heater heats said first external land surface; and  
a second heater heats said second external land surface.

25 29. An apparatus as in claim 21 wherein said pattern roller has a depth of at least 6 microns.

30 30. An apparatus as in claim 28 wherein said first heater operates at a different temperature than said second heater.

30 31. An apparatus as in claim 21 comprising:  
a first end seal at a first end of said external land die;  
a second end seal at a second end of said external land die;  
and

wherein said first end seal and said second end seal prevent said material from leaking past said first and second end of said external land die.

32. An external land die for extruding a material comprising:  
5 a first external land surface;  
a second external land surface; and  
wherein said first external land surface and said second external land surface form a trapezoid with respect to a surface of a patterned roller.

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33. An apparatus as in claim 32 wherein:  
said first external land surface creates a diverging region with respect to a direction of rotation of said patterned roller; and  
said second external land surface creates a converging 15 region with respect to said direction of rotation of said patterned roller.

34. An apparatus as in claim 33 wherein a first hydrodynamic pressure created in said diverging region is less than a second hydrodynamic pressure created in said converging region.

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35. An apparatus as in claim 34 wherein said second hydrodynamic pressure is in excess of 10 atmospheres to compress entrapped air in said material.

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36. An apparatus as in claim 33 wherein:  
a first heater heats said first external land surface; and  
a second heater heats said second external land surface.

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37. An apparatus as in claim 36 wherein said first heater operates at a different temperature than said second heater.

